



The Dryden

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Fueled by fat

Biofuel could reduce oil dependence, aircraft emissions

By Gray Creech
Dryden Public Affairs

NASA recently conducted emissions testing on alternative, renewable fuels in pursuit of a greener and less petroleum-dependent future for the nation. The search for alternative fuels is driven by environmental concerns as well as a desire for reduced reliance on foreign sources.

“Renewable” means the fuel source isn’t some form of fossil fuel. The source could be algae, a plant such as jatropha or even rendered animal fat. In late March and early April 2011, a Dryden team tested renewable biofuel made from chicken and beef tallow in one of the four engines of a DC-8 airplane.

The aircraft remained on the ground during the test, known as the Alternative Aviation Fuels Experiment, or AAFEX, while aeronautics researchers measured the fuel’s performance in the engines and examined engine exhaust for chemicals and contamination that could contribute to air pollution. It was the first test ever to measure biofuel emissions for nitrogen oxides, commonly known as NOx, and tiny particles of either soot or unburned hydrocarbon – both of which can degrade air quality in communities



ED11 0093-25

NASA Photo by Tom Tschida

Researchers check out emissions detection equipment set up behind NASA’s DC-8 flying laboratory during ground tests of alternative biofuels derived from animal fats at the Dryden Aircraft Operations Facility.

with airports. NOx contributes to smog, and particulate matter contributes to respiratory and cardiovascular ailments. “The test results seem to support the idea that biofuels for jet engines are indeed cleaner-burning, and release fewer pollutants into the air. That benefits us all,” said Ruben Del Rosario of Glenn Research Center in Ohio. Del Rosario manages NASA’s Subsonic Fixed Wing Project, through which the experiment was sponsored as part of the agency’s Fundamental Aeronautics Program.

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Discovery complete

Two crewmembers discuss the orbiter’s last mission

By Jay Levine
X-Press Editor

Dryden employees gained insight into Space Shuttle Discovery’s final mission when its commander and a mission specialist visited April 26.

STS-133 Commander Steve Lindsey and mission specialist Alvin Drew explained elements of the 13-day mission that entailed attaching a new storage module to the International Space Station, bringing spare parts and preparing the orbiting laboratory for future research.

Lindsey and Drew are familiar with Edwards Air Force Base; both were assigned to the Air Force Test Pilot School. Drew is a veteran of two shuttle flights, both on Discovery. Lindsey is a veteran of five shuttle missions on three orbiters, three on Discovery and one each on Atlantis and Columbia.

Discovery’s final crew also included pilot Eric Boe and mission specialists Michael Barratt, Nicole Stott and Steve Bowen, who was a late replacement when lead spacewalker Tim Kopra was injured and could not make the flight.

One mission task called for teaming up with the space station crew to move an equipment platform out of the shuttle’s cargo bay and onto the station’s truss. Barratt and Stott operated the space station’s robotic arm and handed it off to the shuttle’s robotic arm, which Boe and Drew operated, and the platform was maneuvered to its permanent location on the station’s backbone.

Drew described some of the maneuvers with the robotic arms on the shuttle and ISS as “break-dancing maneuvers.” The platform, called the Express Logistics Carrier, had been loaded on Earth with spare parts for the station, including a radiator to cool station systems.



ED11 0125-15 NASA Photo by Tony Landis

Space Shuttle Discovery Commander Steve Lindsey, left, and mission specialist Alvin Drew share highlights of the orbiter’s final mission with Dryden employees April 26.



ED11 0125-31 NASA Photo by Tony Landis

Discovery crewmembers sign autographs following their talk.

During the mission, Drew and Bowen left the station’s Quest airlock for two spacewalks. Working outside Discovery’s cargo bay and on the station, the two completed installation of the Italian-built Leonardo module, which was retrofitted with meteorite shielding and other gear. Now called the Permanent Multipurpose Module, or PMM, it is essentially a closet for

storing equipment and supplies. Barratt and Stott used the robotic arm a second time to attach the new module to the station’s underside, connecting it to the Earth-facing side of the Unity module.

Also among the host of new science experiments and hardware was the Robonaut 2, the first dexterous humanoid robot in

space. Its first priority is testing its own operation in microgravity, but upgrades are intended that will develop it as an astronaut assistant for dangerous or boring tasks.

The astronauts answered questions about their best memories in space and their experiences with the space shuttles.

“What really sticks with me was the first time I looked out the window on my first mission,” Drew said. “I was stringing some coaxial cable for a local area network when I looked out, and it was one of those ‘you’re not in Kansas anymore’ moments, especially when a satellite whizzed by about one kilometer away.”

Lindsey agreed that the view from space is extraordinary.

“I think something that sticks with you no matter how much time you have in space is seeing Earth from space,” he said. “It’s spectacular, and it never gets old. Every time you look at the Earth, you see something different even if you’ve flown over it a thousand times.”

Drew related a story about the STS-133 mission patch, which originally was commissioned to aerospace artist Robert McCall. McCall completed several mission patches, including the one for STS-1, and also created several murals and paintings on display at Dryden, the most recent a painting of Neil Armstrong.

Just before the artist’s death, he was at work on the STS-133 patch and Drew didn’t expect to see the preliminary designs. After McCall died, the family sent the patch designs and NASA commissioned another artist to combine two of the variations.

Another query concerned seeing meteor showers and color in space.

See Discovery, page 7



ED09 0253-02 NASA Photo by Tom Tschida
Discovery previously landed in California Sept. 11, 2009, after mission STS-128 to the International Space Station. In all, Discovery has made 15 landings at Edwards, including at the close of the shuttle program’s return-to-flight mission following the loss of Columbia on Aug. 9, 2005.

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“You see meteors below you, which is really cool,” Lindsey said. “Through the window, you look down at Earth and you can see the meteors entering the atmosphere. As for colors, you can see all kinds. Every hour-and-a-half, you orbit the Earth so every 45 minutes you see a sunrise or sunset. As opposed to just seeing the sky dim, as you do on Earth, you can actually see multiple color bands in the atmosphere.

“I think, one time, I counted 12 or 13 colors. At night, if you turn off all the cabin lights so there are no reflections you can see unbelievable stars in all kinds of different colors that you don’t see even in high-altitude flight. It’s pretty spectacular.”

Concerning training, Lindsey said the timeframe is usually about a year, but delays with STS-133 made it more like a year-and-a-half. Having to replace a member

of the crew four months away from the launch presented a challenge, which was met by having the new crewmember focus on the spacewalks and dividing other duties among the rest of the crew.

In addition, American astronauts for decades have had to learn Russian as part of their training so as to be able to communicate with the Russians on the ISS, but also because American astronauts have been hitching a ride to the ISS on the Russian spacecraft Soyuz for more than six years, Lindsey said.

The shuttle commander thanked Dryden employees for their roles in shuttle support.

“We need shuttle support here [in order to] to fly out there,” he said. “From the bottom of our hearts, thank you for making Discovery’s last flight a success.”

The landing at Kennedy Space Center marked the conclusion of Discovery’s 39th mission to orbit;

it is the first space shuttle to be retired by the agency. Discovery has flown more missions than any other shuttle in the fleet, carrying the Hubble Space Telescope to orbit and sending the Ulysses robotic probe on its way to the sun. It was the first shuttle to rendezvous with the Mir Space Station, and delivered the Japanese Kibo laboratory to the ISS.

Among the 180 passengers it carried was Eileen Collins, the first female shuttle pilot and, on another mission, the first shuttle female commander. Bernard Harris became the first African American spacewalker and Jake Garn became the first sitting member of Congress to fly in space, on STS-51D, in April 1985.

The two Discovery crewmembers said that although the vehicle will no longer travel into space it will continue to inspire young people as they reach for the stars.

NSSC News

The latest news from the NASA Shared Services Center is available.

The NSSC Customer Satisfaction and Communication team works to communicate with its customers at the centers and ensure information is reaching those who need it.

The NSSC News, a quarterly publication designed to provide succinct and informative updates on NSSC activities, is available at https://searchpub.nssc.nasa.gov/servlet/sm.web.Fetch/Final_.pdf?rhid=1000&did=931764&type=released.

Tech forum

The 2011 NASA Earth Science Technology Forum is set for June 21-23 at the Westin Pasadena in Pasadena, Calif.

The forum is intended to spur collaboration and facilitate a better understanding of NASA Earth science technology developments.

For more information, visit: <http://esto.nasa.gov/conferences/estf2011>.



May 6, 1960 – A U-2A from North Base was brought to the Flight Research Center and painted in fictitious NASA markings with a bogus tail number (55741). News media representatives were allowed to photograph the aircraft to support the cover story that Francis Gary Powers, who had been shot down over Russia in a U-2 on May 1 was on a NASA research flight.

May 22, 1975 – Jacques Cousteau visited the FRC and watched John Manke land the X-24B. Cousteau greeted Manke on the lakebed after touchdown, with Manke exiting the aircraft wearing diving flippers.

Launching the era of space shuttles

STS-1 marked the beginning of a 30-year program that concludes later this year

By Jay Levine
X-Press Editor

Astronaut Bob Crippen spoke to Dryden employees April 15 about his mission as the pilot of the first space shuttle mission, which concluded at Dryden 30 years earlier.

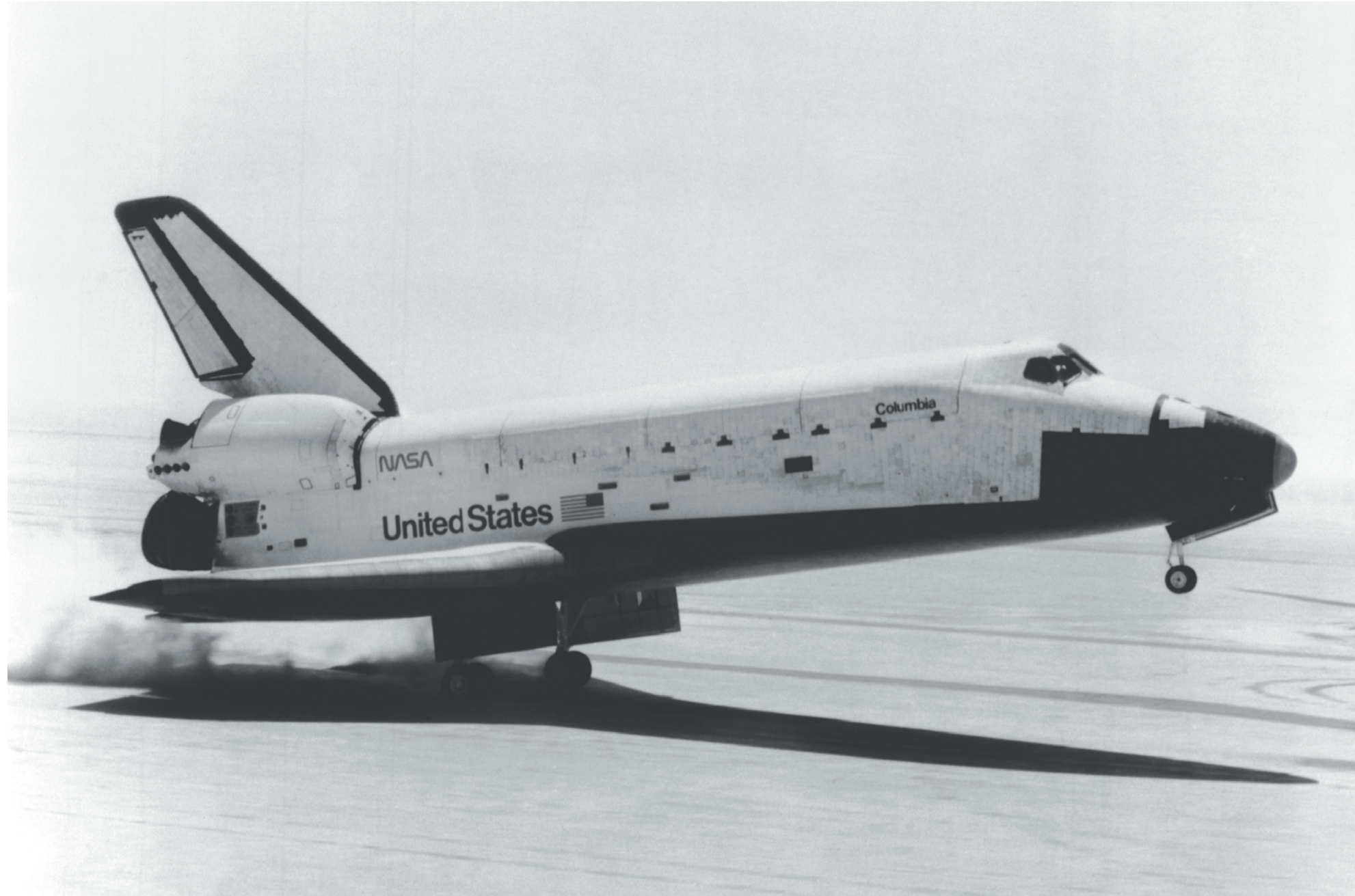
Crippen and shuttle commander John Young landed Columbia April 14, 1981, on Rogers Dry Lake, as unprecedented crowds came to Edwards Air Force Base to see the landing.

Crippen explained that early on, there was debate about leaving the crew off of the first flight in favor of an automated landing. However, it was determined that the shuttle system's complexity required a crew capable of reacting to an emergency, he said.

Although there were ejection seats on the first four shuttle flights – acquired from the high-altitude, Mach 3-plus SR-71 – they were “primarily a placebo,” Crippen said.

“There was a ton of flame from the solid rocket boosters. If you ejected, you would have to go through that and you would get very toasty,” he added.

On launch day, he said only after the clock started ticking down under one minute did he believe the STS-1 mission would really begin. The computers had not been communicating with each other a few days earlier, and he was



EC81 15104

expecting a scrub.

But all systems were go and it was “quite a ride” going 17,000 miles per hour. The solid rocket boosters shook Columbia, a feeling he likened to “driving my pickup fast over a washboard country road.”

The Columbia was “well above

our trajectory,” he said, and he watched as the solid rocket boosters jettisoned from the orbiter. Then the acceleration began to trail off and it was quiet.

“I thought we had lost the main engines,” he said. Everything was fine and it was time to start the mission.

Once Columbia was in orbit, Crippen released himself from the confines of his seat and began to make his way around the shuttle. “It’s topsy-turvy without gravity,” he said. “‘Up’ was whatever direction I was pointed.”

He floated over to the control panel facing the payload bay doors

to open them, standard practice when an orbiter gets to space as a means of releasing heat from the radiators. Once the doors opened, he said, “John, look at that,” as he pointed to some areas where there were dozens of missing tiles, the thermal protection needed to safely return the orbiters to Earth.

The missing tiles were not essential, but the two men were concerned about what might be missing on the hottest areas of Columbia’s underside. The two astronauts were fairly confident they would land safely.

See STS-1, page 8



Photo courtesy Jay Levine

At left, Columbia lands on Rogers Dry Lake to mark the successful conclusion of the first space shuttle mission, known as STS-1. Above, astronaut Robert Crippen shared memories of his involvement on STS-1, which ended at Edwards 30 years ago last month.



NASA Photo

Columbia commander John Young, left and pilot Bob Crippen are pictured prior to the STS-1 mission. As with most of the early shuttle missions, STS-1 concluded with a landing on Rogers Dry Lake.

ER-2 supports precipitation study

By Beth Hagenauer
Dryden Public Affairs

A NASA aircraft and its suite of scientific sensors are being used in a study of convective cloud and precipitation processes that entails observation and measurement of the entire process, from the formation of ice near the top of the clouds to the rain that falls to the ground. NASA’s high-altitude ER-2 arrived at Offutt Air Force Base, Neb., April 22 for use in a six-week study in support of the Global Precipitation Measurement, or GPM, mission. That mission will begin in 2013. In it, an international constellation of satellites will be used to study global rain, snow and ice to improve understanding of Earth’s climate, weather and hydro-meteorological processes.

In the current study the ER-2, acting as a satellite simulator, carries instruments that sample the entire column of atmosphere below the aircraft to verify that data collected produce a consistent summary of precipitation physics. Those data will be used to improve the accuracy of future satellite instruments. A Cessna Citation operated by the University of North Dakota conducts in situ sampling in the clouds and precipitation beneath the ER-2.

Three NASA instruments are mounted in the ER-2 for the Mid-latitude Continental Convective Clouds Experiment, or MC3E,



ED10 0383-08

NASA Photo by Tony Landis

NASA environmental science ER-2 aircraft No. 806 takes off from the Dryden Aircraft Operations Facility at Air Force Plant 42 in Palmdale, Calif., for a mission in the skies above California’s Mojave Desert.

campaign. The High-altitude Imaging Wind and Rain Profiler, or HIWRAP, is a dual-frequency radar that maps three-dimensional winds and precipitation within severe weather events. The sensor, developed by Goddard Space Flight Center in Greenbelt, Md., was previously flown on a NASA Global Hawk during the fall 2010 hurricane mission.

Scientists at Marshall Space Flight Center in Huntsville, Ala., have redesigned the Advanced Microwave Precipitation Radiometer, or AMPR, instrument to improve the accuracy with which it detects the type of precipitation present in a storm as well as its ability to distinguish how Earth’s surface characteristics influence the interpretation of measurements

being made by radiometers. By identifying more precisely the type of precipitation present and the effects of a particular land surface on the measurement, the AMPR may present scientists with recognizable signatures that could allow improved precipitation estimates to be made from space.

Scientists at Goddard originally developed the Conical Scanning Millimeter-wave Imaging Radiometer, or CoSMIR, to validate clear-air satellite data. The CoSMIR instrument recently was modified to play the role of an airborne high-frequency simulator for the GPM mission’s microwave imager. The radiometer is located in an ER-2 wing pod and, for the first time, will be used to provide data about snow and ice particles in clouds at various elevations while flying at an altitude of 65,000 feet.

Though the aircraft is being flown from the Nebraska air base in the MC3E study, the areas being targeted during the campaign – co-sponsored by NASA and the Department of Energy – are central and northern Oklahoma. The ER-2 is scheduled to return June 4 to its home base at NASA’s Dryden Aircraft Operations Facility in Palmdale, Calif.

More information about the MC3E precipitation-measurement study is available at <http://www.nasa.gov/topics/earth/features/rain-campaign.html>.

NASA council visits

The NASA Advisory Council Aeronautics Committee held meetings April 14-17 at the Aerospace Education Research and Operations – AERO – Institute in Palmdale, Calif., and at Dryden’s main campus at Edwards Air Force Base.

Members were here for updates on the NASA Aeronautics budget from Jaiwon Shin, Aeronautics Research Mission Directorate associate administrator.

The committee also heard a Dryden overview from Center Director David McBride, and briefings from Dryden staff about aeronautics projects, including Uninhabited Air Systems in the National Air Space and drag reduction through laminar flow, on the Gulfstream III.

A tour at Dryden offered a look at assets such as the Ikhana aircraft, which the group is seen viewing in the image at left.



ED11 0116-14

NASA Photo by Tony Landis

NRC board visits Dryden

Members of the National Research Council’s Aeronautics and Space Engineering Board toured Dryden April 20. The study team reviewed several aeronautics research projects, specialized aircraft and research facilities as part of its three-day visit.

The NRC board has been tasked with providing an assessment of NASA’s aeronautics flight research activities, and the tour and briefings served as an introduction to aeronautical research activities under way or planned for the future at Dryden.

This was the first meeting of the team in its data-gathering mission. The study is expected to take 18 months and provide NASA’s Aeronautics Research Mission Directorate with recommendations about how best to integrate flight research into the current fundamental research and integrated systems research activities.



ED11 0120-54

NASA Photo by Tom Tschida

Gary Cosentino briefs Apollo 11 astronaut Neil Armstrong, left, on the X-48C engine during a National Research Council tour at Dryden.

Jack Kluever dies at age 85

Retired Army Col. Emil “Jack” Kluever, 85, died April 23. A helicopter test pilot, Kluever was detailed to the Flight Research Center at Edwards Air Force Base in the mid-1960s as a test pilot on the Lunar Landing Research Vehicles.

Kluever was the only pilot to fly LLRV No. 2, which was flown just six times during a brief flight test program at Edwards in early 1967. It was then transferred to Ellington Air Force Base, near Houston, where it was used for spare parts to keep the first LLRV and three Lunar Landing Test Vehicles used in the Apollo astronaut lunar landing training program airworthy. LLRV No. 2 has been partially restored and is preserved in the collection of historic aircraft at Dryden.

Kluever also flew several test flights in the Paraglider Research Vehicle – or Parasev – at the Flight



NASA Photo

Retired Army Col. Emil “Jack” Kluever, who flew Apollo-era Lunar Landing Research Vehicle test flights in the mid-1960s, died April 23.

Research Center in 1964. The enabling future spacecraft to glide Parasev was a small experimental to an airplane-style landing. craft designed to explore the While at Edwards, Kluever potential of a flexible, fabric-covered attended the Air Force Test Pilot Rogallo wing design as a means of School, graduating with class 60B.

News at NASA

Plans laid for ISS future

The Multilateral Coordination Board for the International Space Station partner agencies met April 27 to discuss increased efforts to use the station as a test bed for exploration. Board members also congratulated the European Space Agency on its recent decision to continue station operations through at least 2020.

The MCB is working to extend the benefits to future exploration beyond low-Earth orbit through enhanced station research and technology development. Other topics on the agenda included a report on efforts to create international standards for docking and berthing; rendezvous and proximity operations; and standardization of command protocols for spacecraft.

The International Docking Systems Standard is available at <http://www.internationaldockingstandard.com>.

Station research projects with potential societal impact include the Alpha Magnetic Spectrometer-2, to be flown aboard STS-134; the Canadian Space Agency’s continuing life science research program; the ESA’s GeoFlow experiment in the Fluid Science Laboratory payload; and additional projects by Japan and Roscosmos, the Russian Federal Space Agency.

The MCB meets periodically to ensure coordination of station operations and activities among the partners. Japan and the Russian Federation already have approved continued station operations beyond 2016. The CSA is working to reach consensus about the continuation of the station.

Biofuel... from page 1

The team ran one engine using Hydrotreated Renewable Jet Fuel, or HRJ, and another using Jet Propellant 8, or JP-8, fuel, which is very similar to the industry-standard Jet-A fuel used in commercial aircraft. A 50-50 blend of the two fuels was also tested.

The experiment’s chief scientist, Bruce Anderson of Langley Research Center in Virginia, said that in the engine that burned the biofuel, black carbon emissions were 90 percent less at idle and nearly 60 percent less at takeoff thrust. Anderson added that the biofuel also produced much lower sulfate, organic aerosol and hazardous emissions than did standard jet fuel. Researchers will spend the next several months comparing the results and drawing conclusions.

The recent test came a little more than two years after the same team used the same airplane to test two synthetic, or manmade, fuels derived from coal and natural gas. Researchers found that the synthetic fuels significantly reduced particulate emissions at all engine power settings and also saw some smaller reductions in gaseous emissions at certain engine-operating conditions.

“Dryden was excited to contribute to the study of alternative fuels for aviation use,” said Frank Cutler, NASA’s DC-8 flying laboratory project manager. “The results of these tests will tell us a lot about emissions generated by modern turbine aircraft engines using these fuels.”

The test setup involved positioning the DC-8 at Dryden’s Aircraft Operations Facility in Palmdale, Calif., surrounded by ground support equipment, emissions sensors and test equipment trailers that housed researchers and observers.

The AAFEX tests in 2009 and this year were funded through NASA’s Aeronautics Research



ED11 0093-1 NASA Photo by Tom Tschida

An emissions detection rake device is positioned behind engine no. 3 on NASA’s DC-8 flying laboratory during ground tests of an alternative jet fuel made from chicken and beef tallow.

Mission Directorate. federal organizations and academia. The experiments included Seventeen government, industry and investigators and consultants academic organizations participated from private industry, other in the recent test.

STS-1... from page 5



ED06 0045-3 NASA Photo

Huge crowds gathered to see Columbia’s landing at the conclusion of STS-1.

The engines were fired for the deorbit burn halfway around the world from the landing site; the outside glowed pink and it felt like “flying through a neon tube,” he said.

As Columbia approached the landing site, Crippen said he could see the huge mass of vehicles and people there to welcome them back to Earth.

As the final flight in the shuttle program nears, later this year, there will be a lot of conversation about the achievements of the shuttle program and the inspiration it created.

However, it’s the crew of two that completed what is considered one of the greatest flight tests in history that ushered in a new era in human space flight.

The X-Press is published the first and third Fridays of each month for civil servants, contractors and retirees of the Dryden Flight Research Center.

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